Perceptual and Motor Skills, 1985, 60, 831-842. © Perceptual and Motor Skills 1985

TEMPORAL LOBE SIGNS: ELECTROENCEPHALOGRAPHIC VALIDITY AND ENHANCED SCORES IN SPECIAL POPULATIONS

KATHERINE MAKAREC AND M. A. PERSINGER[1]

Laurentian University

Summary.—Internal and external validity tests were completed for an inventory that has been uesd to infer signs of temporal lobe lability. Strong, positive correlations were reported for a normal (reference) population between the numbers of responses that referred to paranormal experiences (including feelings of a "presence") and separately to religious beliefs and the numbers of spikes per minute within electroencephalographic recordings from the temporal lobe. Numbers of spikes were also correlated with the subjects' scores on the hysteria, schizophrenia, and psychasthenia scales from the MMPI. These clusters of items were not correlated with electrical activity from the occipital lobe (the comparison region). Numbers of responses to control clusters of mundane experiences were not correlated with the temporal lobe measures. A group of student poets scored higher on different subclusters of temporal lobe signs and on the schizophrenia and mania scales of the MMPI than the reference group. For both groups, there were positive correlations between the amount of alpha activity in the temporal lobe only and answers to items such as "hearing inner voices" and "feeling as if things were not real." These results demonstrate that quantitative measures of electrical changes in the temporal lobe are correlated with (or with the report of) specific experiences that are prevalent during surgical or epileptic stimulation of this brain region.

Mystical, paranormal, and religious experiences are hypothesized (Persinger, 1983) to be associated with some temporal lobe factor in the human brain. This factor is expected to correlate with the neuroelectrical conditions that evoke similar but fragmented experiences during surgical stimulation of particular regions of the temporal lobe (Gloor, 1972; Horowitz & Adams, 1970). The frequency of occurrence and the varieties of these experiences for a person are predicted to reflect the electrical lability of temporal lobe structures and the social-psychological conditions that contribute to this lability (Persinger, 1983). The details of the experience and their attributions are a function of reinforcement history.

Several clinical studies have indicated a high frequency of "temporal lobe signs" such as religiosity, circumstantiality, and viscosity (Geschwind, 1983) in patients with epileptic foci in this portion of the brain (Slater & Beard, 1963; Bear & Fedio, 1977). However, the existence of these signs within the experiential history of normal individuals who report religious or mystical experiences has not been considered until recently. Both Neppe (1983) and Fenwick (1983) reported more frequent temporal lobe signs in populations

[1]Send reprint requests to Neuroscience Laboratory, Department of Psychology, Laurentian University, Sudbury, Ontario, Canada P3E 2C6.

that displayed enhanced psi or parapsychological experiences. The hypothesis indicates that there should be a systematic relationship between the numbers of temporal lobe signs in normal individuals and their propensity to report religious and paranormal experiences. Implicitly the hypothesis predicts that temporal-lobe signs reflect a continuum of temporal lobe lability along which persons are distributed depending upon the duration and extent of the occurrence of these signs in day-to-day behavior.

An inventory of 140 items and provisionally called the Personal Philosophy Inventory has been devised and tested (Persinger, 1984a). Thirty-four of these items are combined to form different clusters that reflect the types of experiences that are most frequently associated with either surgical stimulation or biogenic focal (epileptic) stimulation of the temporal lobe. Factor analyses on 20 of the 29 items (no paranormal references) that contained pq values between 30 and 70 indicated that the items were not redundant for a sample of 100 subjects. Subclusters of these temporal lobe signs isolate the intensity and the type of display. In addition, separate clusters of items comprise routine psychological experiences; they are used as controls for both the propensity to answer yes (or its equivalent) to general experiences and to unusual experiences. Other items are used to evaluate prevarication. Relevant personal history and beliefs are also surveyed.

Names of the major clusters (sample items in parentheses) were: normal psychological references ("Once in a while, I think of things too bad to talk about"), mundane proprioceptions ("When I am really upset, I feel my hands shaking"), oddity items ("Every so often, I feel like gripping my thumb within the fingers of the same hand"), the general temporal lobe cluster (29 items); ("Sometimes an event will occur that has special significance for me only"; "once I start talking in an enjoyable setting, I have a hard time leaving"; and the paranormal experiences ("Sometimes I can read another person's thoughts"), subclusters of the temporal lobe scale were feeling of presence ("At least once in my life very late at night, I have felt the presence of another Being") and depersonalization ("I have had experiences when I felt as if I were somewhere else"). A new subcluster that highlighted the basic themes, the auras from temporal lobe (complex partial) epileptics, was called the temporal lobe aura cluster and included items such as "There have been times I have stared at an object and it appeared to become larger and larger"; "when I walk upstairs, I sometimes note a strange smell from nowhere"; "while sitting quietly, I have uplifting sensations as if I were driving quickly over a rolling road."

In addition, there were two belief clusters, that included dogmatic religious beliefs ("Everything is turning out just like the Bible said it would"; "if God told me to kill, I would do it in His name"), and more exotic fantasy-

related beliefs ("I would like to time travel"; "there is probably life on other planets"). Finally, a lie scale cluster was composed of selected items from the MMPI. The number of yes responses (or their equivalents) in each cluster were divided by the number of items to give a percentage of affirmative responses and to allow comparisons between clusters and between this and previous studies.

The test-retest reliability of the temporal-lobe sign clusters was 0.90 after 10 days for one group of 20 university students and 0.65 to 0.70 after 100 days for another group of 100 university students. The inventory has been shown to be internally consistent. For example, the correlation between scores on the paranormal report cluster and the temporal-lobe cluster are positive and moderately strong (0.60 to 0.70) (Persinger, 1984a, 1984b). People who report they have had a strong religious experience score higher on the temporal-lobe cluster than those who do not report these experiences. Not surprisingly, there is also a strong correlation between religious belief and the report of a profound religious or mystical experience.

The present study was designed as an initial test of the construct validity of this inventory. We hypothesized that there should be positive correlations between the scores on the clusters of temporal-lobe items and specific EEG (electroencephalographic) activity within the temporal lobe. However, there should be no or very weak correlations between these items and EEG activity within a comparator region such as the caudal occipital section and no or weak correlations between control clusters (mundane psychological experiences) and temporal lobe activity. Because auditory experience and temporal-lobe function have an intricate association, the scores on the inventory should be more strongly correlated with the temporal-lobe activity following sound stimuli rather than the activity during baseline conditions or during visual stimulation.

Although the essential hypothesis is that religious and mystical experiences are correlated with microseizures at the time of the experiences (Persinger, 1983), we reasoned that individuals who have these experiences should also show enhanced numbers of temporal-lobe experiences in general. They would reflect greater lability or involvement of the temporal lobe and would be correlated with a chronic alteration in cortical activity. This chronic effect of temporal lobe cortical activity should be enhanced in situations that were conducive to the display of endogenous temporal lobe activity, such as quiet settings, where the subject sits with eyes closed and is exposed to sudden, infrequent stimuli (Halgren, *et al.*, 1980).

Even though the subcortical structures are expected to display greater lability and the actual width of the cortical columns that are associated with electrical activity may be too small to be discerned by classic electrode placements (Goldensohn, 1983), we expected that general activity specific to the

temporal lobe but not to the occipital (reference) area should be evident. There is compelling evidence that large areas of the temporal lobe may display shared electrical lability, particularly for electrical transients, even when deeper foci are involved (Schwartzkroin & Knowles, 1984).

As an additional check of the general validity of the inventory, we tested a group of poets. Anecdotally, poets are supposed to be prone to controlled but often compulsive periods of "hypergraphia", multiple "insights", and feelings of profound knowing (peak experiences). We consider these symptoms to be less severe but qualitatively similar manifestations of the personality profiles associated with some forms of temporal lobe epilepsy. Whereas the latter would be associated with chronic foci and confounding symptoms, the former behaviors would be associated with transient and subclinical occurrences. Consequently, we expected the poets to score much higher on all aspects of the temporal lobe signs and to demonstrate substantially different EEG profiles than the sample of the general university population. Since we expected these differences to be very gross, we reasoned that they would be obvious within even a small sample.

Since the hypothesis indicates that temporal lobe signs should be evident to various degrees among normal individuals, the MMPI was administered to all subjects to rule out traditional clinical pathology. To ensure rigor of evaluation, two measures of EEG activity were selected before the study began. The first was the number of seconds that contained alpha frequency per min. The second was the number of transient excursions ("spikes") per min. In addition, we decided to evaluate the total record for each subject rather than random segments to minimize sampling error. Finally, we decided to evaluate the records first (by the first author) and to calculate the inventory scores afterwards to reduce any possibility of the experimenter's biasing.

METHOD

Subjects

A total of 28 subjects were involved in this study. In Group I, the reference group, 8 men and 10 women served as subjects. They included most of a single class from a third-year psychology course. The average age was 29.5 yr. and ranged from 20 to 48 yr. old. Each subject was given a 2% bonus mark for participation. In Group II, student-poets were recruited. They maintained active writing schedules. There were 3 men and 7 women. All but one was in the second to fourth year of university. Their ages ranged from 21 to 30 yr. and averaged 23.5 yr. They were asked to be subjects in the experiment and did not receive bonus marks.

Procedure

Each subject was escorted into the laboratory (Persinger, 1984c) and asked

to sit on a chair facing a wall that was approximately 1.5 m away. E45 silver-plated disc electrodes from a Grass Model 79 electroencephalograph were attached in a bipolar arrangement to the scalp near the apex of the ear (approximately T3-T4). A second set of electrodes were attached along the same horizontal plane on the scalp over the occipital bone (approximately 01-02). Ground electrodes were attached to the left hand. All electrodes were maintained in position by EC-2 electrode paste; the scalp electrodes were also maintained by a loose band around the head. Special attention was given to ensure that the band was not too tight. While the electrodes were attached, the general purpose of the study was explained: to test the correlation between personality and EEG variables.

The subjects were instructed to minimize movement, to achieve a comfortable position in the chair and to remain relaxed for the next 16 min. Following a check to determine the optimal amplitude for each pair of leads and to detect any conspicuous artifacts (e.g., from swallowing), the subjects were told exactly how the experiment would progress and the specific instructions to expect. The basic procedure involved alternating minutes of eyes open and eyes closed. Near the beginning of each minute, the subjects were told either to close their eyes and keep them closed or open their eyes and keep them open.

The first 5 min. (3 eyes open, 2 eyes closed) were used as baseline. The second 4 min. involved sound stimuli. It was presented for 10 sec. at the beginning of each minute before the instructions to close the eyes were given. The sound stimuli were segments from an Astral Sounds Tape (San Francisco, CA); it contained exotic tones and beats that ranged between 7 and 10 beats per sec. The sounds were presented about 1.5 m behind and slightly to the left of the subject by a tape recorder; the sound level near the ear was 71 ± 1 db according to a Sound Level Meter.

After a 1-min. interval, the next 4-min. segment involved the presentation of a light stimulus during the first 10 sec. of each minute. The light was generated by a General Radio Model 1836 strobe scope that was placed at eye level about 1.5 m in front of the subject. To minimize potential glare to the subject, the beam was covered by a plastic opaque material. This allowed the subject to look directly into the light. The pulse frequency was 7 Hz. The last 2 min. of the session involved one eyes-open and one eyes-closed intervals. At the end of this segment, the subjects were asked to blink their eyes or to swallow to determine conspicuous artifacts in the records.

The instructions were read by one experimenter[2] who carefully timed (by a stopwatch) their presentations. The second experimenter monitored the EEG which was taken continuously during the experiment. He or she constantly monitored the records for potential alpha driving by the external stimuli

[2]Thanks to Mary Jonik for her assistance.

and for any other potential signs of epilepticity. This experimenter also marked the record when the stimuli were presented and stopped and noted any movement artifacts by the subjects. Subjects were given the EEG sequence over a 3-wk. period, and between 3 days to 3 wk. after administration of the Personal Philosophy Inventory and the MMPI.

Every second of each subject's record for the 16 min. of measurement were evaluated. Each second of the record for each output (temporal and occipital) was given either a 0 or 1 for each of two measures. The first measure was the presence alpha frequency for more than 0.5 of the second. The second measure was the presence of a transient excursion whose amplitude was at least twice (peak to peak) that of the general activity. These transients were called spikes. The number of alpha seconds per min. and spikes per min. for each of the 16 min. were determined. For the minutes that involved the presentation of a stimulus, these measures were taken separately for the stimulus period (the 10 sec.) and for the remaining period that followed (50 sec.) separately. Movement artifacts were also measured but they are not reported in this study.

The first analysis involved the general measures of alpha seconds per minute and spikes per minute in the temporal or occipital leads during either the eyes open or eyes closed minutes for the entire experiment regardless of baseline or stimulus type. The second level of analysis differentiated the measure of alpha seconds and spikes for each lead and eye open/closed condition for the four phases: baseline, sound, light, and reference. Close attention was given to the measures during the brief stimulus presentation periods.

All statistical analyses were completed by SPSS software on a DEC2020 System Computer. Personal Philosophy Inventory clusters were computed (COMPUTE) according to previous procedures (Persinger, 1984a, 1984b). Alpha frequency and spike measurements for each lobe (temporal versus occipital) were also determined by the use of computer operations and checked manually. In this study, the major analyses involved Pearson and Spearman (nonparametric) correlations between the EEG measures and the Personal Philosophy Inventory clusters. Scattergrams were visualized to detect possible outliers or nonlinear trends. Separate (ONE-WAY) analyses of variance were completed between the poet and nonpoet groups for the MMPI, inventory, and EEG measures.

RESULTS

The results of the Pearson and Spearman analyses for the reference groups indicated that the significant correlations ($p \leq .05$) between the temporal-lobe clusters and the EEG measures occurred with temporal-lobe activity but not with occipital lobe activity. The strongest statistically significant ($p \leq .01$) correlations (Spearman and Pearson coefficients, respectively in parentheses) occurred between the numbers of spikes in the temporal lobe when

the eyes were open and the scores on the religious belief or dogma cluster (0.67, 0.76), paranormal or mystical cluster (0.50, 0.52), and the feeling of presence cluster (0.49, 0.50).

There were statistically significant negative correlations between alpha activity in the occipital lobe when the eyes were closed and the scores on the normal psychological experience (—0.50, —0.48) clusters. All other correlations between the various alpha measures in the temporal lobe or spike measures from the occipital lobe were not statistically significant; the values varied between ±0.30. Separate analysis for men and women only or as a function of age did not alter the results in any statistically significant manner.

Several statistically significant correlations were noted between only temporal-lobe EEG measures and MMPI scores. The average numbers of temporal-lobe spikes per minute during the eyes-open condition were correlated with hysteria (0.49, 0.52), paranoia (0.42, 0.48), psychasthenia (0.55, 0.63), schizophrenia (0.48, 0.53), and social introversion (0.48, 0.53). The average numbers of alpha seconds per minute in the temporal lobe when the eyes were open were also correlated with scores on the psychasthenia (0.47, 0.68) and schizophrenia (0.50, 0.64) scales. The population displayed scores that were within the normal range. The means and standard deviations for the standardized scores for the scales that were statistically correlated with the EEG measures were schizophrenia (55.5 ± 11.3), psychasthenia (55.3 ± 11.8), and social introversion (51.9 ± 11.1).

Correlations for the various EEG measures between the occipital and temporal lobes indicated associations that have been seen many times before in this laboratory. There were statistically significant ($p \leq .001$) correlations for the average numbers of alpha seconds per minute between the eyes-open and eyes-closed periods within the occipital (0.76, 0.79) and within the temporal (0.81, 0.77) lobes. However, there were no significant correlations between the numbers of alpha seconds *between* the temporal and occipital lobes for either the eyes-open or -closed condition.

To facilitate comparisons with further studies, the means, standard deviations, and ranges of the reference group for the average number of alpha seconds per minute were: occipital open 1.6 ± 1.9 (0 to 5.4), occipital closed: 13.1 ± 10.7 (0.3 to 34.5), temporal open: 1.5 ± 1.5 (0 to 6.4), and temporal closed: 2.4 ± 1.8 (0 to 6.6). For the average numbers of spikes per minute, the values were occipital open: 0.8 ± 0.8 (0 to 3.1), occipital closed: 0.6 ± 1.0 (0 to 3.4), temporal open: 1.0 ± 0.8 (0 to 2.3) and temporal closed: 0.7 ± 0.8 (0 to 3.6).

To determine whether any specific modality was associated with larger correlations between the EEG and behavioral measures, separate analyses were completed between the EEG measures for the open- and closed-eyes conditions

for the baseline, auditory and visual intervals, respectively. The same basic relationships were evident. However, the correlation between the paranormal cluster and the number of spikes in the temporal lobe was higher during the auditory period ($r = 0.60$) than either the baseline or visual period. Although we visually inspected the EEG records for the periods of the 10-sec. periods of the stimulus presentations, we did not analyze them since no blatant peculiarities were evident.

To ensure that the reference population, despite its small size, displayed characteristics that were similar to those in previous studies, *a posteriori* one-way analyses of variance were completed between those who reported a religious experience. Only four subjects (22%) of the 18 reference subjects reported they had. The subjects who reported religious experience displayed significantly ($F = 5.72$, $df = 1/16$, $p < .05$) more temporal lobe alpha when the eyes were closed (4.1 ± 1.7) than those who reported no (1.8 ± 1.6) experience. No other EEG measures were statistically significant. In addition, there were no significant differences ($p > .05$) between the two groups on any of the MMPI measures. On the other hand, the religious experients displayed significantly higher scores on all of the temporal lobe clusters and subclusters. These differences accounted for between 35 to 40% of the variance. The experients were particularly higher on a cluster that emphasized temporal-lobe aura themes (30 ± 8% vs 8 ± 11%; $F = 11.98$; $\Omega^2 = 43\%$, $p < .01$). However, there were no statistically significant differences between the experients and nonexperients on the control clusters of mundane psychological experiences (75 ± 6% vs 78 ± 12%), usual proprioceptive experiences (45 ± 20% vs 54 ± 15%), oddyes answers (25 ± 10% vs 25 ± 25%) or the lie index (80 ± 10% vs 76 ± 16%).

Two-way analyses (all dfs = 1/24) of variance by poet (nonpoet vs poet) and sex were completed on the major temporal lobe and control clusters, MMPI scores and EEG measures. Poets scored significantly ($F = 13.5$, $df = 1/24$, $p \leq .001$; $\Omega^2 = 38\%$) higher (83 ± 23%) than nonpoets (35 ± 35%) on the languaging subcluster, our within-inventory validity measure for this population of student-poets. Poets displayed more frequent yeses (or the equivalent) on the general temporal-lobe cluster without traditional paranormal references (47 ± 13% vs 21 ± 10%), the depersonalization subcluster (30 ± 19% vs 8 ± 15%; $F = 11.63$; $\Omega^2 = 31\%$), and the new temporal-lobe aura cluster (41 ± 22% vs 12 ± 12%; $F = 18.22$; $\Omega^2 = 40\%$). However, there were no significant differences between poets and nonpoets on the control clusters of normal psychological experiences, mundane proprioceptions, oddyes, and the lie items. There were neither statistically significant sex differences nor interactions of poet by sex.

On the other hand, poets scored significantly ($p < .01$) higher relative to the nonpoets on the schizophrenia (70 ± 13% vs 55 ± 11%; $F = 7.90$;

$\Omega^2 = 25\%$) and mania (74 ± 12% vs 55 ± 9%; $F = 21.94$; $\Omega^2 = 50\%$) scales of the MMPI. There were no significant differences between the groups on the other MMPI scales. There were no significant interactions of sex by poet although there was a statistically significant sex difference on the MF scale. Whereas men scored 65.5 ± 6.9, the women scored 50.0 ± 7.9 ($F = 31.73$, $df = 1/24$; $p < .001$; $\Omega^2 = 55\%$). Compared to nonpoets, poets displayed significantly ($F = 7.28$) more alpha activity (seconds/minute) in the occipital lobe when the eyes were closed (24.2 ± 8.5 vs 13.1 ± 10.8). There was also a tendency for the poets to display more frequent alpha activity in the temporal lobe with eyes closed (6.8 ± 6.0 vs 2.4 ± 1.8). There were no statistically significant differences in any of the spike measures in either lobe between the two groups. Similarly, there were neither significant sex differences nor interactions of sex by poet. Since there was one poet who displayed inordinate amounts of average alpha seconds per minute in the occipital lobe when the eyes were open (14.7) and closed (50.0), these analyses were completed with as well as without this subject. Addition of this extreme outlier merely enhanced the directions of the EEG results.

Since there were no statistically significant differences between the age of the poet and nonpoet groups, we combined the two to discern another pattern that might be evident. The most robust relationships between the EEG measures and the temporal lobe related or MMPI clusters were all attenuated but still statistically significant. Interestingly, a significant correlation between the average numbers of alpha seconds in the temporal lobe with eyes closed and the scores on the general temporal lobe scale (that did not include items from the paranormal or belief clusters) was statistically significant (r and $\rho = 0.55$) when the groups were combined.

Several *post hoc* analyses were completed to ensure that there were minimum artifacts in the sample. There were no statistically significant differences among the seven people who said they had learned to meditate and those who did not on any of the EEG, Personal Philosophy Inventory, and MMPI measures. Similarly, those people who said they attended church at least once per month ($n = 9$) did not score significantly different on any of the measures compared to those who did not report church attendance. There was no obvious bias from religious affiliations (Catholic vs Protestant). In addition, no one in this sample said yes to the items intended to discern "silly" responses.

A chi-squared analysis indicated that whereas six of the 10 poets reported a religious experience only four of the 18 reference subjects reported this experience; however, the corrected χ^2 was nonsignificant ($\chi^2 = 2.52$, $p > .10$). We checked the means of the four groups that were derived from the poet vs nonpoet and religious experience vs nonreligious experience groups. The poets who reported a religious experience displayed the highest scores on the temporal lobe clusters. The nonpoets who reported a religious experience and

the poets who did not report a religious experience were similar. The lowest scores were displayed by the nonpoets, nonreligious experients.

Discussion

This study is the first attempt to establish external validity of the temporal-lobe sign/cluster inventory, the Personal Philosophy Inventory (Persinger, 1984a, 1984b). These results clearly demonstrated strong, positive and statistically significant correlations between clusters of items that are indicative of temporal-lobe signs (Persinger, 1983, 1984a) and temporal lobe electrical (EEG) activity but not occipital-lobe activity. The latter measure was used as a comparator to ensure that any potential correlations between temporal-lobe signs and temporal-lobe activity were not a general artifact of transencephalic EEG profiles.

Strong positive correlations were noted between the numbers of spikes per minute in the temporal lobe and the scores on the mystical (paranormal) clusters and the religious dogma clusters. The mystical or paranormal clusters contain items that refer to classic descriptions of telepathy and clairvoyance, a symptomatology that is also strikingly similar to the DSM III (Diagnostic Statistical Manual of Mental Disorders), description of the schizotypal personality disorder. The religious belief cluster (no overlap with items from the temporal lobe cluster) contains items dominated by the kind of dogma that frequently occurs in descriptions of "intense religiosity" (Bear & Fedio, 1977). Interestingly, paranormal or mystical references and religiosity dominate the behavior of many temporal-lobe epileptic patients (Geschwind, 1983). Although EEG spikes, as we defined them, are persistent but infrequent (about 1 to 3 a minute) displays in our samples of the student-population, their existence tends to be ignored in the EEG literature for normal populations. Our control procedures seem to reduce the possibility that they are mundane vascular or motoric artifacts.

On the other hand, there were no statistically significant correlations between the average numbers of temporal-lobe spikes and the scores on the normal psychological, mundane proprioceptive, oddyes and lie scale clusters. This suggests that the correlations between temporal-lobe spikes and either the mystical reports or the religious-dogma measures were not an artifact of excessive affirmative responses to private behaviors or to unusual experiences. It also indicates that the items that are not frequently associated with the experiences evoked by temporal-lobe stimulation are also not correlated with our measures of temporal-lobe activity. In this respect, the significant correlation between temporal-lobe activity and appropriate clusters but the lack of correlation between the control clusters and temporal-lobe activity can be considered a form of convergent and discriminant validity (Anastasi, 1976).

The reference group did not display significant correlations between the numbers of alpha activity seconds per minute and any of the clusters. When

the total population was combined (poets and nonpoets), there was a significant correlation between the general temporal-lobe cluster (without paranormal items) and the number of alpha seconds per minute for the temporal lobe only. One explanation for this discrepancy may have involved the sample of reference subjects. Whereas scores on this cluster typically range between 12% to 80% for first-year students (Persinger, 1984a), the range in the present sample was between 0 and 40%. The addition of the poets' scores to this population extended it to within a more typical range. Obviously, a replication study is in order with first-year students who display the usual range in temporal-lobe scores.

With the exception of the narrower range in general temporal-lobe scores, the reference population was strikingly similar to other samples (Persinger, 1984a, 1984b). In previous studies (Persinger, 1984a, 1984b), 22% of each of two populations reported that they had had an intense religious experience. The demographic characteristics were also very similar to previous samples. There was an almost even split in the percentage of Catholics and nonCatholics and a 4:3 predominance of females. However, with the exception of the MF scale on the MMPI, gender differences were never apparent in any of the other measures.

Two measures of internal validity were indicated despite the small samples. First, the differences between poets and nonpoets on the various temporal lobe clusters accounted for 30% to 50% of the variance on these measures. Poets scored substantially higher on the general temporal-lobe cluster and its subclusters such as the aural signs of temporal-lobe epilepsy, feelings of presence and depersonalization. On the other hand, the poets did not report more religious beliefs although they attended to score peculiarly higher on the exotic belief cluster (such as "I would like to time travel").

The second measure of internal validity was the replication of profiles displayed by those who reported a religious experience compared to those who did not. Previous reports indicate that people who display a religious experience should also score substantially higher on the temporal-lobe cluster in general and the feelings of presence and the paranormal cluster in particular. These results were replicated in this study. In addition, those four subjects who reported a religious experience also displayed more temporal-lobe/alpha activity per minute in the temporal lobe than those who did not report such an experience. Interestingly, they displayed alpha activity that was more like the poets who in turn, despite their small numbers, had reported more religious experiences.

There were many intricate and both internally and externally consistent results in the present study. They are compatible with the hypothesis that a temporal-lobe factor is associated with the propensity to experience (and to report) religious and mystical experiences. The major question is why has

the relationship not been reported previously by other researchers? We suspect that the patterns are already there but have been traditionally restricted to the population of temporal-lobe epileptics. The prevalence of these symptoms within the normal population would raise crucial issues.

In addition, we were particularly careful in maintaining an exact protocol with our subjects. Unlike many studies that sample records or emphasize crudely visible response anomalies, we measured *all* of the record quantitatively. We found no qualitatively peculiar spike and wave from changes that would typically reflect more exaggerated and potentially confounding symptomatology. The existence of a quantitative relationship between temporal-lobe measures and the temporal-lobe clusters further suggests the existence of a continuum of temporal-lobe signs within the normal population.

REFERENCES

ANASTASI, A. *Psychological testing.* New York: Macmillan, 1976.

BEAR, D. M., & FEDIO, P. Quantitative analyses of interictal behavior in temporal lobe epilepsy. *Archives of Neurology*, 1977, 34, 454-467.

FENWICK, P. B. C. Some aspects of the physiology of mystical experiences. In J. Nicholson & B. Foss (Eds.), *Psychology Survey No. 4.* Leicester: British Psychology Society, 1983. Pp. 203-223.

HALGREN, E., SQUIRES, N. K., WILSON, C. L., ROHRBAUGH, J. W., BABB, T. L., & CRANDALL, P. H. Endogenous potentials generated in the human hippocampal formation and amygdala by infrequent events. *Science*, 1980, 210, 803-805.

HOROWITZ, M. J., & ADAMS, J. E. Hallucinations on brain stimulation: evidence for revision of the Penfield hypothesis. In W. Keup (Ed.), *Origin and mechanisms of hallucinations.* New York: Plenum, 1970. Pp. 13-22.

GESCHWIND, N. Interictal behavioral changes in epilepsy. *Epilepsia*, 1983, 24(Suppl. 1), S23-30.

GLOOR, P. Temporal lobe epilepsy: its possible contribution to the understanding of the functional significance of the amygdala and of its interaction with neocortical-temporal mechanisms. In B. E. Eleftheriou (Ed.), *The neurobiology of the amygdala.* New York: Plenum, 1972. Pp. 423-457.

GOLDENSOHN, E. S. Symptomatology of nonconvulsive seizures: ictal and postictal. *Epilepsia*, 1983, 24(Suppl. 1), S5-S21.

NEPPE, V. M. Temporal lobe symptomatology in subjective paranormal experients. *Journal of the American Society for Psychical Research*, 1983, 77, 1-31.

PERSINGER, M. A. Religious and mystical experiences as artifacts of temporal lobe function: a general hypothesis. *Perceptual and Motor Skills*, 1983, 557, 1225-1262.

PERSINGER, M. A. People who report religious experiences may also display enhanced temporal lobe signs. *Perceptual and Motor Skills*, 1984, 58, 163-197. (a)

PERSINGER, M. A. Propensity to report paranormal experiences is correlated with temporal lobe signs. *Perceptual and Motor Skills*, 1984, 59, 583-586. (b)

PERSINGER, M. A. Striking EEG profiles from single episodes of glossolalia and Transcendental Meditation. *Perceptual and Motor Skills*, 1984, 58, 127-133. (c)

SCHWARTZKROIN, P. A., & KNOWLES, W. D. Intracellular study of human epileptic cortex: *in vitro* maintenance of epileptiform activity? *Science*, 1984, 223, 709-712.

SLATER, E., & BEARD, A. W. The schizophrenic-like psychosis of epilepsy. *British Journal of Psychiatry*, 1963, 109, 95-150.

Accepted March 22, 1985.